

AGENDA ITEM#

March 15, 2002

To: Delta Protection Commission CALFED Committee

From: Margit Aramburu, Executive Director

Subject: Applications for Funding from the CALFED Ecosystem Restoration Program
(For Commission Consideration and Possible Delegation to the CALFED Committee)

BACKGROUND:

CALFED received 260 applications in October 2001. The projects have been reviewed by region, and are currently under administrative and external review, and review by technical panels. A Selection Panel will meet April 1-4 and make funding recommendations to be released at a public workshop. This release will start a public comment period. Final action will be in May.

The administrative reviews include review using the following criteria:

- Willing seller
- Consistent with County/City General Plan, or evidence of local government support
- Higher priority for land not mapped as Prime, Statewide Importance, or Unique Farmland, or where use remains agriculture
- Ecological criteria: biological richness, connectivity, historic biological importance, unique habitat opportunity in relation to meeting CALFED goals
- Time sensitive acquisition opportunity.

RECOMMENDATION:

The Commission should review the attached applications. Due to the timing, the Commission should:

- **Direct staff to schedule a meeting on April 25, if PSP recommendations are available from CALFED by April 8 for analysis and mailing, or**
- **Authorize the CALFED Committee to prepare comments on the consistency of the selected PSP applications with the Commission's Land Use Plan and Law, and earlier written comments to CALFED re: ecosystem restoration projects.**

The CALFED Committee reviewed the descriptions of applications and indicated that several acquisition projects should be reviewed in more detail.

Note: Most of the projects are research projects. Only two are for acquisition of land in the Primary Zone: Old River Committee-146 ac north of Old River, San Joaquin County; and Solano Land Trust-775 acres near Barker Slough, Solano County.

Number	Location	Project Description	Comments
E. 1	Knightsen, Contra Costa County (no specific site)	Develop drainage program/project; restore wetland habitat	Addresses ag and urban runoff issues
G. 2	North, East and Central Delta	Ecosystem Restoration Planning	
I. 1	Old River, San Joaquin County (146 acres)	Acquisition and restoration of Delta Island	Wildlife friendly alfalfa; restoration of riparian oak woodland; interpretive trail
I. 2	Pembco Property, Solano County (775 acres)	Acquisition and restoration of wetland habitat; incorporate grazing	Part of corridor between Prospect Island and Jepsen Prairie Preserve
J. 1	Sun River Property, Sacramento County (537 acres)	Restore land previously acquired through CALFED	Within Stone Lakes National Wildlife Refuge
J. 2	Rhode Island, San Joaquin County (67 acres)	Enhance habitat on channel island.	Island owned by Department of Fish and Game
J. 3	West Big Break, Contra Costa County	Enhance wetland habitat	Land owned by East Bay Regional Park District
J. 4	Marsh Creek and Big Break, Contra Costa County	Enhance wetland habitat at Marsh Creek	Land owned by East Bay Regional Park District
J. 5	Dutch Slough, Contra Costa County (1,200 acres)	Acquisition and restoration of wetland habitat	Secondary Zone
J. 7	Various waterways, Sacramento County	In-channel riparian habitat restoration	
J.9	McCormack-Williamson Tract, Sacramento County	Wildlife-friendly levees	Land owned by The Nature Conservancy
K. 4	Staten Island, San Joaquin County	Wildlife-Friendly Agriculture Project	Ducks Unlimited Rice Project

A. AT-RISK SPECIES ASSESSMENTS *(Seven Projects)*

1. Population Biology and Genetics, Habitat Modeling, and Pilot Restoration for Three CALFED At-Risk Plant Species in the Sacramento-San Joaquin Delta and Suisun Marsh, DFG

DFG proposes to study three important tidal wetland at-risk plant species: Mason's lilaeopsis, Delta mudwort, and Suisun thistle. DFG would collect data on species population viability, location, genetic structure and diversity, and life-history characteristics for the purpose of developing a population model. These data will be used to determine preservation priorities and provide information on population source genetics for restoration and life-history characteristics that are important for population establishment and growth. The data collected from the population size and viability will be used to develop performance standards for ranking population viability. DFG would also collect detailed data to develop a habitat model based on microhabitat variables (including tidal elevation, tidal flux, salinity, total suspended sediments, surface and subsurface light levels, water and substrate nutrients, substrate texture, and plant associates) that are needed to develop restoration strategies. DFG will test its habitat model by developing pilot restoration experiments, which would be monitored to determine whether the at-risk species are establishing and growing similar to natural control populations.

2. Biological Assessment of Green Sturgeon in the Sacramento-San Joaquin Watershed – Phase 5, UC Davis

The green sturgeon (*Acipenser medirostris*) is an anadromous, native fish that occurs in low numbers in the Bay/Delta system. Basic life history information is critical to this species' protection, and the project's targeted research focus is on describing the biological characteristics of this species and its habitats for conservation and potential restoration. UCD has completed Phase 1 & 2 studies of GS and given technical presentations of results and is currently conducting Phases 3 and 4 research. Phase 5 will have six tasks: determine juvenile developmental stage-related swimming performance, salinity tolerance, salinity preference, gill chloride cell activation, and osmoregulatory responses and stress responses to environmental changes; establish reliable artificial reproduction for research and the methodology for determining sex and gonadal maturity; use unique genetic markers to identify sibling among GS located on their breeding areas by telemetry, plankton tows, and egg traps in order to estimate the number of breeding adults at each spawning; determine the movements and distribution of adult GS tagged with ultrasonic and radio beacons, and tracked either by airplane, automobile, boat or listening stations, within the Sacramento, San Joaquin, and Klamath Rivers and describe the habitats in which they reside, with particular attention paid to their spawning grounds; capture subadult and adult during a one month period in winter (Jan./Feb.) and a similar period in summer (Aug.) in San Pablo Bay (using trammel net samples).

3. Occurrence and ecological impact of xenobiotics as potential endocrine disruptors in Splittail (*Pogonichthys macrolepidotus*) in the lower Sacramento-San Joaquin River drainage, USFWS.

This investigation will quantify and evaluate the degree to which alkylphenol ethoxylates (APE) impact native fishes endocrine systems; the species evaluated will be the Sacramento splittail (*Pogonichthys macrolepidotus*). The investigation will determine the presence of vitellogenin, an endocrine disruption biomarker, in the blood of male Splittail. To confirm and quantify effects, laboratory studies will be conducted to compliment field surveys. Other federal and state water

quality regulators can use the information to develop more protective discharge permits that can lead to improved best management practices for agriculture and urban watersheds to reduce the risks of fish exposure to endocrine disrupting compounds. Monitoring and sampling will take place on the San Joaquin and Sacramento River and North and South sections of the Delta

4. Integrated Assessment of Delta Smelt Condition Factors for Determining Contaminant and Food Web Effects on Population Dynamics, UC Davis

The goal is to develop an understanding of population dynamics and provide a framework for a future delta smelt study plan that is guided by 2 key features of the population: 1- Low fecundity and a primarily annual life-cycle implies that population persistence is enhanced by maximizing growth and reproductive development during recruitment. 2- A diverse and interactive array of potential mechanisms occurs within and among years, as well as locations in the delta smelt habitat. Research plan consists of an integrated approach to quantify mechanisms determining growth, including food limitation, parasitic infection, and exposure to contaminants using spatially-explicit stage-structured population models to relate the relative significance of growth variation to other potential sources of mortality (i.e. entrainment) and restoration actions (EWA) that may influence population dynamics. This project builds on current work in which we have developed (1) histopathology biomarkers of contaminant exposure and organ/tissue condition; and (2) biomarkers of DNA damage, as well as (3) otolith growth rate analyses of individual smelt from the monitoring programs in 1999-2000. The 3 year work plan includes (4) evaluations of contaminant concentrations and (5) ambient bioassays using water samples from the delta smelt habitat, (6) biomarkers and outplant experiments, and (7) syntheses using spatially-explicit stage-structured models.

5. Delta Smelt Culture and Research Program, UC Davis

The on-going Delta Smelt Culture Project is a successful research and development program currently funded by the CALFED Bay-Delta Program. This project aims to deliver a reliable and enhanced supply of cultured delta smelt to numerous research programs, while improving culture protocols through UCD's own investigative work. Research efforts are directed in two areas that currently restrict production: larval nutrition and spawning. The culture of delta smelt requires the annual capture of sub-adults and daily maintenance of the progressive life stages (broodfish, eggs, larvae, juveniles and subadults) for 12 months of the year (Task 1). Effect of varying the fatty acid levels in larval food will be evaluated in terms of growth, survival, and stress tolerance of larval smelt (Task 2). Effect of spawning-substrate type on spawning behavior will be measured in terms of total number of eggs deposited on each substrate type in large outdoor tanks (Task 3).

6. Assessing Health Indices and Migratory Patterns of Fish to Support Restoration Effort, UC Davis

The research proposal objectives are to: 1) determine health indices of bluegill, longfin smelt and Splittail from three habitats and life styles; 2) determine migratory patterns of Splittail and longfin smelt; 3) investigate metallic contaminant effects on bluegill, longfin smelt, Splittail and sturgeon; and 4) assist in testing effectiveness of floodplain restoration activities. UCD predicts that using otoliths and fin rays for age identifications and LA-ICP-MS to determine chemical fingerprinting in growth increments will enable them to reconstruct the migratory pattern of the fish, hence, allowing them to track fish movement based on chemical environments and provide data as to their whereabouts from early to adult life stages or in between spawning. Laboratory exposure provides specific bioindicators of metal exposure help to evaluate and validate field exposure. An integrated health response with respect to metallic contaminants exposure will be derived by incorporating liver and gonads metal concentrations, otolith and fin rays elemental fingerprinting, histopathology, and conditional index into multivariate analyses, will provide site-

specific health index of each fish species. Integration of these results with ongoing efforts by CALFED-funded IEP studies to monitor effort of improving Bypass floodplains and to survey fish populations will enable us to evaluate the health of floodplain habitats. Geographic locations selected will be Sutter and Yolo Bypass, vicinity of Sacramento-San Joaquin Rivers adjacent to the Bypass, Suisun Marsh, Cosumnes River floodplain, and areas of the Delta adjacent to Cosumnes and Mokelumne rivers.

7. Assessment of CALFED Priority Wetland-Dependent Wildlife, USGS, Dixon Field Station

CALFED habitat restoration and resource management programs will have both local and landscape impacts on wildlife. An understanding of the response of priority wetland-dependent species, including giant garter snakes (*Thamnophis gigas*), migratory waterfowl, and Sandhill cranes to habitat changes at all geographic scales provides crucial information to the adaptive management model of the ERP program. Knowledge of habitat use by these wetland-dependent wildlife species will also provide critical information to guide the wildlife-friendly farming program. The current range and status of the threatened giant garter snake in the Delta is largely unknown. The giant garter snake recovery plan calls for more complete surveys for distribution and abundance, identification of giant garter snake habitat in the Delta, and research on habitat requirements. Task 1 (giant garter snakes) will address the goals of the recovery plan, with specific objectives of evaluating the status of giant garter snakes and their habitat in the Delta, and determining habitat features important to giant garter snakes. A recent study found that changing agricultural practices and the Central Valley Habitat Joint Venture has changed the ecology and distribution of waterfowl in the Central Valley. One especially notable change has been a drastic decline in the use of the Delta region by greater white-fronted geese (*Anser albifrons*), northern pintails (*Anas acuta*) and other waterfowl. The data provides a baseline against which data collected during Task 2 (Waterfowl Surveys) will be compared to measure the landscape impacts of CALFED programs and restoration projects on migratory waterfowl. The Central Valley of California, including the Delta, provides critical wintering habitat for three sub-species of Sandhill cranes. Mixing of Sandhill crane sub-species on the wintering makes it difficult to use surveys to track status of each sub-species. Also, wintering habitat requirements for these at-risk populations have not been well documented. For Task 3 (Sandhill cranes), we will use satellite and standard tracking of individual cranes to identify key breeding, migration, and staging areas of Sandhill cranes so that status of each population can be determined and identify crane habitat to help target CALFED restoration efforts. Three arctic-breeding white-fronted goose subpopulations are known to use the San Joaquin-Sacramento River Delta and differ in the timing and duration of their use of Delta habitats. The entire Bristol Bay Lowlands population uses the Delta during migration. Task 4 (greater white-fronted geese) will track how habitat use and movements of individuals of each subpopulation change relative to CALFED habitat changes and provide a temporally wide measure for determining the value of altered habitats in the Delta to migratory waterbirds.

B. DECLINE IN PRODUCTIVITY (One Project)

1. Primary Production in the Delta: Monitoring Design, Data Analysis and Forecasting, UC Davis

This proposal builds upon recent research and historical data to improve monitoring in the Delta of phytoplankton production and related water quality variables; to identify and quantify processes regulating long-term change in phytoplankton production and related variables; and to develop forecasting models. The first goal is a sustainable and reliable monitoring program for phytoplankton primary production. Biomass and water quality variables required estimating

production are collected as part of the Interagency Ecological Program (IEP) environmental monitoring program (EMP). The EMP provides critical baseline data for CALFED ecosystem restoration and is currently under review as to methods, station location and temporal frequency. We will utilize the historical database to support refinement of this program. Objectives include identifying subregions that could accommodate a stratified sampling design, and optimizing the collection of continuous monitoring and discrete station data required to bridge the wide range of space and time scales important in the Delta. The second goal is to catalog the processes responsible for interannual variability in phytoplankton production and related quantities. Recent research identified three processes regulating Delta-wide phytoplankton production at seasonal and longer time scales: river inflow, a long-term increase in transparency, and the Potamocorbula invasion. Here, we will extend the analysis on a subregion by subregion, or station by station, basis, using related techniques. The third goal is to develop a forecasting ability. The process-based knowledge will be converted to stochastic models that forecast phytoplankton production and biomass responses on a subregional basis to multiple stressors, including changes in the flow regime and long-term trends in transparency.

C. ECOSYSTEM WATER AND SEDIMENT QUALITY *(Sixteen Projects)*

1. Monitoring pesticide use in Sacramento watershed and estimating pesticide residues flowing into the river system using GIS and environmental modeling, *UC Davis*

This research project would be conducted in the Sacramento region. Intensive human activities in the valley have contaminated the Sacramento River and its tributaries in the watershed with nitrates and pesticides. Large amount of pesticide used in agriculture has caused surface water contamination in the watershed that threatens the sustainability and integrity of the riparian ecosystem along the river. The pesticide use report (PUR) database from California's Department of Pesticide Regulation contains detailed information about pesticide use in California but has not been combined with GIS datasets for environmental modeling. The objectives are (1) to monitor high toxic pesticides used in agricultural lands, including estimation of pesticide use intensity, pesticide loads, and pesticide residues in the fields, and (2) to model the amount of pesticide residues flowing into the river system and the pesticide concentration in the segments of the river. The approach of the study is a combination of PUR database, GIS spatial analysis, environmental modeling and statistical analysis. They would like to test the hypothesis that high use of toxic pesticides in the region contaminates surface water quality, which in turn affects the riparian habitats for fish and other water-dependent species, and hence ultimately threatens the ecosystem sustainability of the Sacramento River system. The expected outcome of the research will include a spatial GIS database and maps showing pesticide-related indices affecting water quality in Sacramento region, including the pesticide use intensity, pesticide loads and pesticide residues in the agricultural landscape, pesticide residues in river systems, spatial distribution of ecological /ecosystem indicators for measuring ecosystem functionality. This GIS database will have a number of themes showing the spatial distribution of each pesticide used in the region, pesticide loads, pesticide residues, pesticide inflows into rivers, the background conditions (soil, drainage system, crops, vegetation, etc.). It also has the assessment maps showing the pesticide-related risks for the riparian.

2. Assessing the Magnitude of and Developing a Management Program for Excessive Bioaccumulation of Organochlorine Pesticides and PCBs in Delta and Delta Tributary Fish, *G. Fred Lee and Associates*

The San Joaquin/Sacramento River Delta and ten other tributary waterbodies have fish with concentrations of organochlorine pesticides (e.g., DDT, etc.) and/or PCBs (together, referred to as OCIs) that are a threat to cause cancer in those who consume the fish. This

situation has caused the Central Valley Regional Water Quality Control Board to develop a TMDL to control the excessive bioaccumulation of OCl_s in fish. The sources of OCl_s to the Delta are runoff from areas of previous use and waterbody sediments. Work done thus far on this Technical TMDL has shown that there is need for information on the magnitude of the problem of excessive bioaccumulation of OCl_s within the Delta and its tributaries, and the sources of OCl_s that are bioaccumulating to excessive levels in Delta and tributary fish. The proposed OCl project will provide needed information on the nature and extent of excessive bioaccumulation of organochlorine pesticides and PCBs in Delta and Delta tributary fish, define the sources of OCl_s in stormwater runoff and irrigation water discharges, and define the role of waterbody sediments in contributing to the excessive OCl_s in Delta fish tissue.

3. *Inventorying and Evaluating Best Management Practices for the Reduction of Non-Nutrient Pollutant Loads, Power Hydrodynamics*

This project would provide urban and agricultural stakeholders with an inventory and evaluation of BMPs applicable to their land uses. By evaluating BMPs that could help with sediment, pesticides, boron, salt, selenium, metals and other contaminants, the land managers will be able to choose BMPs that provide them with multiple benefits for their particular water quality improvement needs. This project began from stakeholders in the San Joaquin River Dissolved Oxygen TMDL steering committee. This project will involve stakeholders with the belief that the more involved the stakeholders are in developing solutions to the problems, the more likely they will be to implement those solutions.

4. *Inventorying and Evaluating Best Management Practices for the Reduction of Nutrient and Oxygen Demanding Substances in the San Joaquin Valley, Power Hydrodynamics*

This project would inventory and evaluate existing research on Best Management Practices that may benefit land managers in the San Joaquin watershed who want to meet load reduction requirements for their contributions of nutrients and oxygen demanding substances. Existing research indicates that non-point source loading of these substances within the watershed contributes to the low dissolved oxygen problem in the Deep Water Ship Channel in the lower San Joaquin River. This project will involve stakeholders from start to finish. Research will be conducted on existing publications and will result in the most comprehensive inventory and evaluation of BMPs pertinent to the San Joaquin Valley. An inventory and evaluation of BMPs relevant to the soils and land uses of the San Joaquin Valley will help local stakeholders craft implementation plans to reduce the non-point loads of nutrients and other oxygen demanding precursors that come from five categories of land uses: urban landscaping/city streets; orchard/vineyards; row crops; pasture/forage/rangelands; and riparian habitat/wetlands.

5. *Mercury in Delta Fish: Establishing a Network for Long Term Study, San Francisco Estuary Institute*

CALFED restoration and water management actions will lead to local and possibly regional increases in concentrations of mercury in aquatic food webs and exacerbate the existing mercury problem. Recent studies in the Delta have found striking regional variation in mercury bioaccumulation. To date little effort has been made to identify local communities who may be impacted by elevated mercury in Delta fish. Long term, multi-disciplinary, process-oriented studies are needed in order to develop a capability to predict the impact of CALFED actions on mercury bioaccumulation and to evaluate the impact of CALFED actions, both on a project and

regional level. Sport fish and prey fish sampling will be included in these studies, as indicators of human exposure, wildlife exposure, and spatial and temporal trends. The goal of monitoring project is to establish a network of long term monitoring sites for tracking the effectiveness of CALFED efforts to minimize mercury bioaccumulation in the Delta region. The objectives of the project are: 1. Establish a sound statistical foundation for evaluating long term trends in mercury bioaccumulation. 2. Provide data on mercury bioaccumulation at selected Delta sites that can be linked to other studies to gain a comprehensive understanding of mercury movement from water and sediment into the food web. 3. Develop an improved understanding of the processes driving interannual variation in mercury bioaccumulation. 4. Provide sport fish mercury data that can be used in evaluating human health risks. 5. Evaluate spatial patterns in mercury bioaccumulation in the Delta. 6. Provide the opportunity for local community involvement in the dissemination of study results. 7. Provide public education and outreach on mercury in Delta fish. 8. Enhance local health department capacity to address public concerns about mercury in sport fish.

6. Field and Laboratory Investigation of Selenium Cycling and Speciation in San Francisco Bay and the San Joaquin River-Delta Sediments, *SF State University*

This research and monitoring project will apply advanced analytical techniques to gain new insight into the cycling of Selenium (Se) between the aqueous and sediment solid phases of selected Bay-Delta field sites, as well as determine the chemical speciation of Se during these transformations. Selenium that occurs in particulate matter as suspended solids will also be studied. We will sample Se contaminated sites located at the San Joaquin River-Delta, San Francisco Bay, and Suisun Bay. The overall objectives of this project involve quantitating and speciating Se in San Francisco Bay and San Joaquin River-Delta field sites, conducting laboratory experiments to investigate Se uptake and bioavailability in sediments under controlled conditions, application of advanced analytical techniques to determine the chemical speciation of aqueous and solid phase Se, and involvement of Bay Area students at the high school and college levels.

7. Restoration Planning for Watersheds Impacting Low Dissolved Oxygen Conditions in the Lower San Joaquin River Near Stockton, *San Joaquin River DO TMDL Steering Committee*

Solving the low dissolved oxygen problem in the Deep Water Ship Channel the lower San Joaquin River is a high priority of the CALFED Ecosystem Restoration Plan. In this project, stakeholders in the San Joaquin watersheds most closely related to the causes and sources of oxygen depletion work together to develop individual watershed restoration plans and help craft the overall SJR DO Restoration Plan. With the completion of independent Peer Review of 2001 CALFED funded studies on the sources and causes of the low dissolved oxygen problem, the stakeholders will know which watersheds contribute most of the load to the downstream problem. It is anticipated that between 3 and 10 watersheds will be involved in resolving the problem. This grant will provide those watershed stakeholders with facilitation, technical and financial resources so that they can understand why they have a loading problem and so that they can develop an implementation plan to meet their share of the overall solution.

8. Evaluation of Mercury Transformations and Trophic Transfer in the San Francisco Bay/Delta: Identifying Critical Processes for the Ecosystem Restoration Program, *USGS*

There has been a substantial recent effort to assess the extent of mercury (Hg) contamination in biota, water and sediment of the San Francisco Bay watershed. An important recent finding has been that certain indicator species (e.g. inland silverside, small mouth bass) have lower mercury concentrations in the Central Delta than in key tributaries, even though benthic MeHg production

appears quite active in Central Delta sediments. It is unclear why this apparent paradox exists. To find out, an intensive process level investigation will focus on two geographic regions contrasting both with respect to previously observed trends in biota Hg levels, and in Hg biogeochemistry. The sites are Franks Tract in the central-delta (low Hg) and the Cosumnes River tributary (high Hg). Our objective is to examine the specific biogeochemical processes and food web transfer pathways that mediate Hg concentration and speciation within and between the biotic and abiotic spheres of these two regions. Our overarching hypothesis is that regional and local differences in the extent of biota Hg contamination can be explained by differences in a number of key processes that we will measure. These include: a) MeHg production and degradation in both the sediments and water column, b) the transfer of MeHg across the sediment-water interface, c) the transfer of MeHg into the base of the food web, and d) Hg biomagnification as a function of food web structure, length, base characteristics (e.g. benthic versus pelagic, phytoplankton versus epiphytic algae) and sub-habitat (submerged vegetated versus non-vegetated, littoral, marsh, floodplain).

9. Investigating in situ Low Intensity Chemical Dosing to decrease Delta waters DOC concentrations and DBP Precursors while accelerating wetland peat accretion rates and reducing flood risks, USGS

The proposal is for the first phase of a project assessing the use of low intensity chemical dosing (LICD) of coagulants to remove DOC and disinfection byproduct precursors (DBPPs) from Delta island drainage water. DBPPs (e.g. trihalomethanes, haloacetic acids) form when chlorine reacts with certain forms of DOC during drinking-water treatment. They are carcinogenic and mutagenic, and regulated by the USEPA. We propose applying LICD in the context of a constructed (treatment) wetland to be used as the settling basin. We hypothesize 1) LICD will significantly reduce DOC and DBPP exports from Twitchell Island; 2) settled flow from LICD will augment peat formation to reverse subsidence; and 3) constructed wetland placement along levees will stabilize the levees through both sediment accretion and a reduction in hydraulic forces. The first phase will include both laboratory and field studies, ranging from small-scale mechanistic studies to large-scale mesocosm studies. In the mesocosm studies to be located on Twitchell Island, we will 1) monitor DOC and DBPP concentration changes, 2) assess organic carbon, metals, and nutrient dynamics, and 3) monitor sediment accretion and floc stability. Benefits include subsidence mitigation and wetland habitat creation.

10. Adaptive real-time Forecasting and Sustainable Management of Dissolved Oxygen in the San Joaquin River and Stockton Deep Water Ship Channel, UC Berkeley

The goal of this project is to develop a forecasting tool to improve sustainable management of episodes of dissolved oxygen (DO) depletion below water quality standards/objectives in the San Joaquin River (SJR) Deep Water Ship Channel. The project will help to integrate the monitoring and modeling components of three currently funded CALFED water quality projects in the San Joaquin River Basin and Delta. This will be achieved by (a) installing state-of-the-art water quality monitors and sensors at existing monitoring stations and adding new stations where necessary and cost-effective; (b) by using satellite telemetry to automate data collection and data reduction in cooperation with the California Data Exchange (CDEC) and the Interagency Ecological Program (IEP) and (c) by adaptively improving the forecasting capability of the DSM-2 hydrodynamic and water quality model of the Delta and San Joaquin River, to predict DO depletion. Management options for control of the DO depletion will be evaluated using the model as directed by stakeholders through the SJR DO Steering Committee (SC) and Technical Advisory Committee (TAC). The SC and TAC will provide detailed information on these management scenarios that may include channel aeration, increased SJR flow through the DWSC and reduced oxygen demand loads from various sources within the SJR.

11. Selenium Effects on Health and Reproduction of White Sturgeon, *Acipenser transmontanus*, in the Sacramento-San Joaquin Estuary, UC Davis

Selenium (Se) is a contaminant in San Francisco Bay-Delta and a potent reproductive toxin threatening higher trophic level species because of its efficient food web transfer. The white sturgeon (WS, *Acipenser transmontanus*), which consume clams containing high levels of Se, have highly elevated tissue Se concentrations that may threaten their health and reproduction. We will determine Se tissue concentrations and their effects on detoxification enzymes and organ histopathology in juveniles, subadults, and adults of WS. We will also test the effects of Se enrichment of egg yolk on survival and development of WS embryos and larvae in laboratory experiments. Two general hypotheses will be tested: 1) Se accumulation affects WS physiology, and 2) Se-enriched egg yolk causes mortality and developmental defects of WS embryos and larvae. We will test the first hypothesis by collecting samples from wild sturgeon (CDFG surveys, party boats, and sturgeon derbies); measuring tissue levels of Se, glutathione, and glutathione reductase and peroxidase; and examining histopathology of liver, gill, gonad and kidney. Physiological responses of the glutathione detoxification system and histopathology scores will be correlated with tissue Se levels to establish threshold levels of Se toxicity. The second hypothesis will be tested in experiments with WS embryos and larvae (from captive broodstock with normal Se levels) injected with organic Se in a range of doses approximating egg yolk bioaccumulation levels. Embryos and yolk sac larvae will be microinjected with Se-L-methionine, and the dose-dependent survival, developmental defects, and glutathione response will be evaluated. These experiments will establish threshold levels of Se in the egg yolk that may affect reproduction and stock recruitment. Tissue from wild sturgeon will be collected in the Sacramento-San Joaquin Delta, San Pablo Bay, and Suisun Bay.

12. Assessment of Hormonally Active Chemicals in the Central Valley Watershed: Monitoring, Activity Measurement, and Quantification of Adverse Effects, UC Davis

Hormonally active chemicals, also called endocrine disruptors, have been detected in water samples from the Central Valley watershed. The magnitude, watershed geographical distribution, and identity of the active compounds are unknown. Whether these chemicals are present at concentrations sufficient to cause adverse effects in fish, wildlife, and humans is also unknown. CALFED has included specific objectives with respect to pesticides and other pollutants with hormonal activity. This proposal: 1) will provide a detailed assessment of chemicals present in the Sacramento-San Joaquin watersheds which have reproductive hormonal activity; 2) will identify and quantify those chemicals; 3) will determine the adverse effects of individual chemicals on the mosquito fish (*Gambusia affinis*), an introduced fish widely distributed throughout the watershed; and 4) will provide an assessment as to the environmental hazard, if any, posed by these compounds. We plan to collect more than 1000 water samples per year, beginning with 8 Central Valley Counties and expanding to 13 Counties in Years 2 and 3. Principle agricultural drains, key river segments, and municipal outfalls will be sampled. Water samples will be screened using highly sensitive, specific estrogen and androgen bio-assays to detect and quantify hormonal activity. Water samples with significant activity will be analyzed by the Toxicology Division of the California Animal Health and Food Safety Laboratory, using the most current analytical techniques available. The results will determine which agricultural and household chemicals with known hormonal activity are entering the watershed, and this study will most probably identify additional active compounds that have never been identified as endocrine disruptors. We will correlate chemicals in the watershed with pesticide use reports compiled by the California Department of Pesticide Regulation (CA DPR), and sample exposed areas of the watershed to confirm and quantify the magnitude of watershed contamination by agricultural chemicals. We will also reconfirm and quantify any chemicals from municipal outfalls. The identified chemicals with the greatest potential for causing adverse effects in fish

and humans will be further tested in the laboratory to determine a dose-response for reproductive impairment of adult mosquito fish, and for developmental impairment of embryo mosquito fish.

13. Development and Implementation of Bioaccumulation-Based Mercury Monitoring in Support of Restoration, Remediation, and the Regulatory Process for Cache Creek, Prospect Island and Adjacent Tracts, the Yolo Bypass, and Cosumnes River, UC Davis

This proposal addresses the development and implementation of bioaccumulation-based mercury (Hg) support monitoring techniques in four regions of particular concern to CALFED: (1) the upper Cache Creek watershed, where major Hg point source remedial targets have been identified, TMDL regulation is slated to be implemented, and critical areas of uncertainty remain unresolved, (2) the North Delta Wetlands Wildlife Region, including the restoration project at Prospect Island and the relatively natural restoration controls of Liberty Island and Little Holland Tract, (3) the Yolo Bypass, which includes large new purchases intended for wildlife refuge and restoration, identified in preliminary studies as a primary Hg methylation region, for which little biological data exists, and (4) the Cosumnes River, site of extensive downstream restoration efforts, identified as the highest Hg concentration major direct tributary to the Delta, for which minimal spatial information exists on absolute and relative levels in biota. Objectives for Cache Creek and the North Delta: identify and explain remaining areas of monitoring-related uncertainty, develop and implement bioaccumulation-based, site-specific Hg monitoring techniques that are in accordance with new EPA guidelines; for the Yolo Bypass and Cosumnes River: provide absolute and spatial information on biotic Hg, contribute to source identification, initiate monitoring of localized, biotic-based performance measures. Approaches include sampling of water, small fishes, and invertebrates. Temporal uncertainty will be addressed with seasonal, diel, tidal, and inter-tidal sampling; spatial uncertainty with transect and sub-habitat sampling. Individual variability in bioindicator species will be tested as necessary. Hypotheses include: (a) spatial, temporal, and additional variability are confounding factors that need resolution before monitoring can be adequately performed, (b) North Delta Hg methylation, bioaccumulation, and export loading are habitat dependent, greatest in highly organic, vegetated areas, (c) small fish and invertebrate bioindicator MeHg, aqueous filtered MeHg, and raw MeHg normalized to TSS are useful performance measures, and (d) the Yolo Bypass and upper Cosumnes River contain elevated biotic Hg that varies spatially in relation to relative MeHg exposure. Expected outcomes: resolution of key areas of monitoring variability, development of new baseline data, development and implementation of bioaccumulation-based Hg performance measures in support of restoration, remediation, and regulatory programs, and new Hg-related strategies applicable to future efforts.

14. Pyrethroid Insecticides: Analysis, Occurrence, and Fate in the Sacramento and San Joaquin Rivers and Delta, USGS

Pyrethroid insecticides are of environmental concern because they are extremely toxic to fish and invertebrates. During the past decade, the use of pyrethroid insecticides has nearly tripled within the watershed for the Sacramento and San Joaquin Rivers and Delta. This increasing use raises valid concerns about the transport of pyrethroid insecticides into surface waters; however, environmental monitoring is difficult because adequate analytical methods are not available for most pyrethroid insecticides. Hydrophobic in nature, pyrethroid insecticides are likely to sorb to sediments and be transported off-site primarily on sediments. The fate and bioavailability of pyrethroids are controlled by their association with sediments and colloids; therefore, understanding the partitioning between the dissolved and particulate phases is critical for assessing the ecological effects. In addition, the extreme toxicity of these insecticides, especially to fish, means that even very low dissolved concentrations may be acutely toxic. Pyrethroids are lipophilic and thus are likely to bioaccumulate in fish. This project proposes to develop analytical

methods for pyrethroid insecticides in a variety of matrices, and then measure their occurrence and fate in the field. The first phase will be to develop routine, multi-residue methods for analysis of pyrethroid insecticides in water, colloids, sediments, and biota. The second phase will be to conduct focused field studies to measure the occurrence and fate of pyrethroid insecticides in the Sacramento and San Joaquin Rivers and Delta, with particular emphasis on partitioning between water, colloids, and sediments. One field study will examine pyrethroid insecticides applied to rice fields. The release of rice field water overlaps in time and space with Delta smelt spawning and larval development. Another field study will examine the off-site transport of pyrethroid insecticides applied as dormant sprays on orchards. The timing of this input into the rivers and Delta coincides with the presence of juvenile Chinook salmon.

15. Development of Ecological Site Descriptions as Integral Components of Digital Soil Survey Information and Predictors of Success of Habitat Restoration, NRCS

The objective of the proposed project is to develop ecological site descriptions containing plant community, ecosystem function, and wildlife habitat data on all soil mapping units found in the Bay and Delta Regions and make this information available to users through a web based information system.. This will foster improved planning for and success of ecosystem restoration efforts. This project is the next phase to CALFED Project #ERP-01-N30, Digital Soil Survey and Orthophotoquad Imagery Development. This proposal will develop tables and narratives of the information to link to soil survey digital linework funded above. Ecological site descriptions (ESDs) are the collective information on sites and can be used in developing and evaluating restoration projects and other conservation measures. The kinds of information typically collected include physical characteristics of the site; major plant communities; plant growth curves; soils information; wildlife communities and habitat; watershed characteristics, (including hydrology); presence of non-native invasive plants; value of the site for recreation and aesthetics; presence of threatened and endangered species, and impact of fires on the site. ESDs will facilitate projects to establish habitat and create sustainable populations of valued species.

16. Organic Matter Composition of Sediments in the Sacramento-San Joaquin River Delta: Past and Present Sources of Organic Carbon and Implications for Ecosystem Restoration, Virginia Institute of Marine Science

Efforts to successfully manage and restore the Delta ecosystem require characterization of the carbon associated with sedimentary organic matter at present as well as an understanding of how carbon delivery to the Delta has changed in response to human activities over time. The proposed work will use a suite of isotopic and molecular tracers ("biomarkers") to characterize organic matter associated with sediments representing past and present conditions in the Delta. The objectives of this study will be to use these "biomarkers" to: (1) provide a thorough analysis of aquatic and terrigenous sources of sedimentary organic matter (SOM) deposited within key sub-habitats of the Delta at present; (2) assess the reactivity (or biological usefulness) of SOM within these sub-habitats, (3) use radiocarbon dating of total organic carbon (TOC) and selected biomolecules to apportion organic matter sources and determine the "ages" of aquatic and terrigenous components of the SOM; and (4) use biomarker distributions in sediment cores to determine how anthropogenic activities have altered the composition of organic matter delivered to the Delta. The information provided by our study is critical to ongoing efforts to: (1) understand recent declines in productivity within the Delta, (2) examine how the quantity and quality of carbon delivered to the Delta has changed in response to past human activities and predict the outcome of proposed restoration strategies, (3) quantify and model the role the Delta plays as a source or sink for carbon and (4) evaluate the role of sediments in Delta water quality (e.g., sediment consumption of dissolved oxygen).

D. ENVIRONMENTAL EDUCATION *(One Project)*

1. Pacific Flyway Center Initial Planning, Yolo Basin Foundation

This is a funding request by the Yolo Basin Foundation (YBF) for initial planning of the Pacific Flyway Center (PFC) – a proposed education/interpretive center intended to serve the general public and local schools. The project will include habitat, trail linkages and a 12,000 square foot educational center presenting educational programs based on regional ecosystems, the functions of the Bypass, and showcasing an array of CALFED actions. The study area is a 69-acre site located in Yolo County, between Davis and West Sacramento and within the Yolo Basin Ecozone. It is situated outside the Legal Delta. The site is about two miles south of I-80, and adjacent to the Vic Fazio Yolo Wildlife Area, and the Yolo Bypass. The project objective is to undertake and complete required planning activities for the site, facility and access route in order to advance the process towards implementing the Pacific Flyway interpretive center.

E. FLOODPLAINS AND BYPASSES AS ECOSYSTEM TOOLS *(Two Projects)*

1. Wetlands Biofilter, National Grants

Knightsen is located in unincorporated eastern Contra Costa County west of Veale Tract and south of Rock Slough. This project will be a continuation of phases necessary for the evaluation and research of a wetlands biofilter for agriculture lands adjacent to the Delta. The eventual implementation of this system will deal with tail waters, floodwaters and stormwaters that impact the Delta. The second objective is habitat restoration. Other outcomes will be improved water quality and restoration of vegetative cover in areas currently used for agriculture.

2. Mercury and Methylmercury Loads to the Yolo Bypass and Delta/Transformations of Mercury and Methylmercury Within the Yolo Bypass, USGS

The Yolo Bypass, because of its position in the hydrologic system, transports much mercury, including methylmercury. Some of the mercury will be transported to the Delta and downstream to portions of the San Francisco Bay, while some portion will settle out within the Yolo Bypass. Currently, little is known regarding the importance of the Bypass in the transformation of inorganic mercury to methylmercury. Newly flooded wetland areas or reservoirs are known to have initially high rates of mercury methylation. These increased rates of methylation in newly flooded reservoirs are caused in part by the availability of nutrients and organic carbon to support microbial populations capable of transforming the inorganic mercury to methylmercury. In addition, little is currently known about the role of agricultural land use within the Yolo Bypass as related to mercury methylation. A number of differing crops, including rice, are cultivated in the Yolo Bypass. Rice production also involves the creation of a seasonal wetland, as fields are flooded from May through August. Some agricultural amendments, such as sulfur, may also increase the rates of mercury methylation because mercury methylation is linked to sulfate reducing bacteria in sediments. A worse case scenario for the Yolo Bypass region is one where agricultural practices stimulate methylmercury production in the summer months, with some of that methylmercury transported downstream during winter high flows, and in addition, the wintertime flooding of the Yolo Bypass also stimulating the production of methylmercury over the entire Bypass region. Understanding of the dynamics of mercury methylation will be of use in determining how best to manage the Yolo Bypass. This project will determine the loads of mercury and methylmercury that are transported through the Yolo Bypass on a yearly cycle, and will also determine the microbiological processes that affect the production and degradation of methylmercury within the Yolo Bypass and in key inputs to the Yolo Bypass.

F. IMPORTANCE OF THE DELTA FOR SALMON *(Two Projects)*

1. Effects of Predation Dynamics on Outmigrating Salmon in the Delta, *Stillwater Sciences*

Declines in juvenile salmonid abundance during outmigration through the Sacramento-San Joaquin Delta have been documented, but there is little information on the specific mechanisms associated with Delta mortality. These mechanisms likely include adequate food supplies, effects of contaminants, effects of diversions, and predation. The CALFED goal of creating shallow-water habitats in the Delta could result in habitat that harbors salmonid predators and increases predation pressure on threatened salmonid species. We propose to document the temporal and spatial scales of predation dynamics on outmigrating salmon in the Delta. Specifically, we will assess patterns in the diet of suspected and known predators in the Delta associated with temporal variability in salmon smolt density, evaluating whether the proportion of salmon smolts in predator diets changes over the period of peak outmigration. We will also assess whether predator species composition and predation dynamics varies between different Delta habitat types and locations. The proposed research project will take advantage of existing monitoring programs and hatchery releases to provide relative abundance estimates of salmon smolts as they migrate through the Delta and to guide the timing of our sampling. Our approach will combine traditional fishery study methods, such as food habit studies and catch-per-unit-effort surveys, with technologically advanced techniques, such as radio-tagging to address predator site fidelity. The study will provide important data to inform habitat restoration actions throughout the Delta, particularly in shallow-water habitats.

2. Decreased Survival of Chinook Salmon Smolt in the Old River: Biological Responses to Contaminants, *UC Davis, Bodega Marine Lab*

Chinook salmon (*Oncorhynchus tshawytscha*) smolt migrating through the Old River exhibit lower survival than do those that pass down the San Joaquin River. Although a large-scale assessment project known as the Vernalis Adaptive Management Program (VAMP) has been implemented, the causes of lower survival in the Old River have never been fully addressed. The objective of this research is to evaluate whether toxicants play a role in decreased survival of chinook salmon smolt that pass down the Old River. We will conduct a smolt caging study under three distinct flow regimes, governed by the VAMP schedule. Sub-lethal responses to toxicant exposure will be evaluated in caged fish, and pesticide and trace metal concentrations measured in composite water samples. We will cage hatchery-reared salmon smolt at three stations in the Old River and three stations in the San Joaquin River for four days. Water samples will be composited daily. At the end of the exposure period, tissues will be dissected within 12h and preserved in liquid nitrogen. Biological responses to be evaluated include: DNA strand breaks, DNA content variation, acetylcholinesterase enzyme activity, stress protein expression, and cytochrome P450 expression. Pesticides will be quantified using capillary-column gas chromatography-mass spectrometry with ion-trap detection, and analytes will be selected based on preliminary GIS characterization of pesticide applications in the lower Delta. Trace metals will be analyzed using ICP-MS. If positive associations between contaminant exposure and biological effects are observed, this will indicate the potential for these contaminants to interfere with restoration of healthy San Joaquin Valley salmon populations.

G. NATURAL FLOW REGIMES *(Two Projects)*

1. Employing a Particle Tracking Model to Simulate Delta Hydrodynamics with Future Delta Infrastructure such as the Through Delta Facility, HDR Engineering, Inc.

We propose to conduct hydraulic analyses for the Delta using existing DWR hydraulic modeling capabilities commonly referred to as the “DWR Particle Tracking Model”. Project Objectives include: § Employ existing particle tracking models in the CALFED agencies’ inventory toward questions on Delta hydrodynamics that have been posed by CALFED program assessment teams. § Determine the effectiveness and accuracy of the PTM in addressing the questions. § Determine what further modeling tools may be necessary to address questions. § Build upon Particle Tracking Model Program Work Team (PWT) past applications (e.g., DSM-2 and DWR PTM). Employment of a PTM will help to reduce uncertainties as to how water particles transport through the Delta and how such transport is affected by new facilities or changes to Delta operations and existing facilities (e.g., the DCC).

2. Geomorphic and Geologic Mapping for Restoration Planning, Sacramento-San Joaquin Delta Region, William Lettis & Associates, Inc.

This proposal is a two-year research study to map geomorphic landforms and geologic deposits in the north Sacramento-San Joaquin Delta input into ecosystem restoration planning and levee engineering. Detailed (1:24,000-scale) mapping is proposed for portions of nine 7.5-minute quadrangles that cover the lower Sacramento, San Joaquin, and Cosumnes Rivers and eastern Delta (Figure 1). Our overall project goal is to provide a regionally consistent GIS dataset that address these restoration priorities within the Region. Our proposed study is designed to establish the geomorphic and geologic framework necessary for; (1) floodplain restoration, (2) evaluation of selective levee breaching, and (3) planning for set-back levee construction on the lower river systems. The deliverables will be GIS products designed as base layers for habitat restoration, levee maintenance and construction, and further scientific research. Based on interpretation of compiled topographic (current and historical), aerial photographic, and soils data, we will produce a series of 1:24,000-scale digital map layers that will show digitized historical (1906-1916) base maps and derivative elevation models; map layers depicting the lateral extent of historical geomorphic landforms (including lateral basins and natural levees) and the distribution and composition of geologic deposits (floodplain, natural levee, stream channels); map layers depicting the locations of sediments deposited by historic placer mining; and, interpretive map layers showing inferred compositions of levees.

H. NON-NATIVE SPECIES *(Four Projects)*

1. Expanded Prevention, Detection, and Control of Purple Loosestrife in the CALFED Bay-Delta Watershed DFA

Purple loosestrife is an aggressive, non-native plant that has invaded North America. In California purple loosestrife currently exists in mostly small, but growing infestations. It poses an escalating threat to almost all wetland and riparian habitats in California. With additional years of treatment purple loosestrife can be significantly reduced if not entirely eradicated. With additional funding, purple loosestrife can be prevented from taking over California's waterways as seen in the northeastern U.S. The project presents a general hypothesis, that loosestrife is present in multiple locations in the Delta system and that it can be locally eradicated, controlled, and contained by implementing regional adaptive management plans. With additional time and resources, the CDFA will carry out a series of tasks that will result in 1) A continued exhaustive yearly survey and mapping of the Sacramento-San Joaquin Delta. 2) Continued and expanded local eradication, control, and containment of loosestrife in the Delta and other hydrological units.

3) An expanded education outreach and training campaign of the boating, fishing, waterfowl hunting, watershed groups, and similar public citizenry.

2. Life History of Egeria Densa in the Delta: Factors Controlling Production & Fragment Viability, Portland State University

The life history of Brazilian elodea (*Egeria densa*), a non-native invasive aquatic plant, will be examined in Franks Tract and its tributaries in the Sacramento-San Joaquin Delta, California and in greenhouse experiments. Life history information for *E. densa* in the Delta is lacking. Life history information on non-native invasive species is critical to management efforts. The objective of the proposed research is to inform *E. densa* management decisions through description of seasonal, morphological, and ecophysiological responses of *E. densa* to important environmental variables. The proposed research will evaluate the following hypotheses: 1) seasonal and environmental (light and temperature) influences on *E. densa* photosynthesis and dissolved organic carbon loss are important determinants of *E. densa* success and can be exploited to enhance efficacy of management actions, 2) seasonal changes in morphology and allocation of nutrients and energy influence ramet demography and growth and can be exploited to enhance efficacy of management actions, and 3) dispersal and establishment success are related to energy and nutrient content and double-node frequency of plant fragments. Seasonal changes in photosynthetic response to light will be examined monthly in the field. Light and temperature response curves for photosynthesis will also be examined in the laboratory for comparison to similar studies on *E. densa* from Florida. Morphological measurements and determination of nutrient allocation to various plant organs (leaves, stems, roots, root crowns, and double nodes) will be measured monthly on field-collected plants.

3. Performance Monitoring of Egeria Control Actions in Franks Tract, West Delta Region, ReMetrix LLC

The proposed study is a monitoring and research project to occur in three phases. The study will monitor *Egeria densa* control efforts by the California Department of Boating and Waterways in Franks Tract, in the west Delta Region. The methods of monitoring use both digital 1-meter multispectral aerial imagery and newly available 2.8-meter multispectral satellite imagery. The aerial imagery is primarily for completing a pre-control and a post-control monitoring project for the 2002 Boating and Waterways season. The aerial imagery will be mapped and statistics will be produced to measure the efficacy of the *Egeria* control efforts in Franks Tract. Phase Three is a comparison of newly available 2.8-meter multispectral satellite imagery with the 1-meter aerial imagery collected for Phase Two. The goal of Phase Three is to determine if quantification of *Egeria* control using the satellite imagery compares favorably to the more-established method of using 1-meter aerial imagery.

4. Invasion dynamics of perennial pepperweed, *Lepidium latifolium*, and their consequences for protection of natural and restored wetlands in the San Francisco Estuary, UC Davis

The relatively recent introductions of two highly successful exotics, *Spartina alterniflora* and *Lepidium latifolium*, threaten the structure and functional integrity of those remaining Bay-Delta wetlands and may have a devastating impact on marsh restoration. While *Spartina alterniflora* is the subject of continuing research, comparatively little is known about *Lepidium latifolium* in light of its potential impact on the Bay-Delta system. *L. latifolium* has been shown to invade riparian corridors, freshwater, brackish, and saline tidal wetlands successfully. The objective of this proposal is to determine the characteristics of *Lepidium latifolium* that facilitate its colonization and of the tidal marshes it invades. This research is expected to reveal demographic weaknesses, which when translated into restoration policy, would help check the establishment of *Lepidium*, enhancing the protection of natural wetlands and preventing its invasion into restored

wetlands. The proposed research focuses on the determination of life history and population biology; the combination of reproductive life history strategies and environmental characteristics associated with *L. latifolium* invasibility; and testing the emerging model of *L. latifolium* environment interactions on simulated tidal marshes, with field verification in San Francisco Bay and Suisun Bay sites. The proposed research should enhance the development of a control strategy for one of the areas most noxious wetland weeds.

I. RIPARIAN HABITAT *(Two Projects)*

1. Delta Island Restoration Project, Old River Committee

The Old River Committee, Inc. a local, community based non-profit, (ORC) requests funds for assistance in the acquisition of land in the South Delta region. The project will include:

- Participation in the development of a wildlife friendly alfalfa growing protocol based on the non-use of diazinon and clorpyrifos,
- A restoration plan for some of the last Great Valley Riparian Oak Forest in the Central Valley using biotechnical methods and constructs,
- A plan for an interpretive trail to give the public access to the rich bio-diversity of the South delta and impart first hand knowledge of agriculture as it is practiced today.

The strategic location will allow for greater flexibility in responding to changing hydraulic conditions in the Delta channels. The area is subject to episodic flooding and we would expect it to continue functioning as part of the floodway during times of high water. This project would extend an existent habitat corridor the shade created by restored riparian oak forest would aid in decreasing water temperatures which would help in meeting dissolved oxygen objectives.

Land acquisition under this proposal will be purchased at an appraised value from willing sellers.

2. Restoring Ecosystem Integrity in the Northwest Delta: PHASE II, Solano Land Trust

The Cache Slough complex in eastern Solano County was once a large and vitally linked ecosystem composed of dead end sloughs and adjacent riparian, marsh, vernal pool and perennial grassland habitats. Although comprising only a small part of the vast Bay-Delta ecosystem, the complex provides essential habitat for numerous resident and migratory species including 29 at-risk species. This proposal focuses on the southern arm of the Cache Slough complex that follows Lindsey Slough west from the Sacramento River where it splits into two smaller dead end sloughs, Barker Slough and Calhoun Cut. This slough system together with adjacent uplands is known as the Jepson Prairie-Prospect Island Corridor (Corridor). The Corridor includes over ten miles of sloughs, 614 acres of riparian and marsh habitat, 38 acres of mid-channel islands and over 17,000 acres of vernal pool/perennial grassland habitats. Our objective is to reestablish vital ecosystem function through the entire Lindsey Slough watershed by restoring important habitat types to benefit 29 at risk species, while simultaneously maintaining compatible agricultural land uses. The four-component project includes demonstration and research projects implemented with numerous partners. The project consists of: ? vernal pool restoration on over 1700 acres including control of non-native species; research on different grazing and burning treatments as restoration techniques; and establishment of an endowment to ensure long term stewardship of the Corridor's habitats. ? acquisition and restoration of 775 acres of the Pemco property along Barker Slough. The acquisition is strategic since the property is contiguous with already protected lands; the restored property will remain in agriculture. ? hydrologic data to determine the feasibility and ramifications of landscape scale restoration focused on levee setbacks and removals. ? an outreach program to strengthen existing partnerships and work with agricultural interests to ensure acceptance and implementation of the CALFED program.

J. SHALLOW WATER, TIDAL AND MARSH HABITAT *(Nine Projects)*

1. Aquatic and Wetland Habitat Restoration for the Sun River Property, American Land Conservancy

The Sun River restoration project requests funds for implementation of a previously-funded CALFED project. The initial grant was for the acquisition, restoration design and permitting of the 537-acre Sun River (a.k.a. Kuhn) property. The American Lands Conservancy (ALC) acquired the property in February 2000. The property will be conveyed to the U.S. Fish and Wildlife Service (USFWS) for long term management when restoration is complete. The 537-acre Sun River property is located in Sacramento County, within Stone Lakes National Wildlife Refuge, and is south of and adjacent to South Stone Lake. Historically, the property contained extensive aquatic and perennial freshwater marshes that were part of the mosaic of habitats associated with South Stone Lake. Since the early 1900s, much of the area's aquatic habitat has been drained or filled to facilitate agricultural development. Currently, approximately 368 acres of the site are uplands, most of which are in agriculture, and the remaining 169 acres of the site are marsh, riparian, and aquatic habitats associated with South Stone Lake. The proposed restoration and enhancement will add approximately 180 acres of marsh, riparian, and other aquatic habitats, as well as enhance/restore 174 acres of associated upland habitat. The restoration involves recontouring and/or building levees, which will restore backwater floodplain habitat and provide flood protection benefits for nearby communities. The completed project will provide and enhance public use opportunities, including environmental education, wildlife viewing, hunting, and boating.

2. Demonstration Project for the Protection and Enhancement of Essential Fish and Wildlife Habitat at Rhode Island, Contra Costa County, Ca., ABAG

Rhode Island is a permanently flooded island located in Contra Costa County. The goal of the proposed demonstration project is to restore and protect Rhode Island and its associated habitats by undertaking the design and construction of a restoration project demonstrating and evaluating appropriate bio-technical techniques for habitat restoration, and determining erosion forces influencing loss of habitat. This project will incorporate information gained from monitoring efforts expended from the Estuary Project's continuing CALFED Ecosystem Restoration Program funded - Demonstration Project for the Protection and Enhancement of Delta In-Channel Islands. This study is designed to monitor the project in detail in order to gather information including vegetation, species richness, establishment of members of scrub-shrub habitat or palustrine forest habitat, terrestrial fauna, sub-tidal fauna, special status species use, longevity of project's structure, erosion reduction, and soil stability. This project was formulated by the San Francisco Estuary Project's Delta In-Channel Islands work group. The primary objectives of this proposed project are to protect and restore shallow water habitats by performing phase I, which includes a site specific erosion forces study and a literature search of appropriate bio-engineering technologies best suited for the conditions at Rhode Island; preparing an appropriate project design, and performing the project's environmental permitting, agency coordination, and environmental review process. Phase II will include project construction, maintenance, evaluation, and monitoring. Adaptive management will be utilized appropriately during the course of this study, in order to best achieve successful objectives. This project includes a long term monitoring program resulting in data gathered to determine habitat use by sensitive species as well as benefits to those sensitive species. This project is ultimately aimed at aiding in the recovery of special status flora and fauna.

3. Biological Restoration, Improvements, and Multidisciplinary Monitoring in the Suisun Marsh/North San Francisco Bay Ecological Zone. Phase Two: Importance of Marsh Ponds, Algae, and other Features along Marsh Channels, CSU Hayward

Our project is located in North San Pablo Bay (Tubbs Island), South Suisun Bay, and West Big Break (near Oakley). It is a Phase II tidal marsh restoration and comparative monitoring project, using non-destructive physical-chemical-biological monitoring with replication throughout each recent and new marsh restoration and (adjacent, ~100-yr-old, relatively natural) reference marshes. Goals are to identify and improve factors that enhance productivity and sustainability of dwindling native populations. Specific objectives of our Phase II proposed project encompass tidal marsh environments from mesohaline to fresh-water in Ecozone 2: (1) further increase tidal action, (2) connect marsh ponds to channels with sills and novel sediment/fish weirs, (3) subsequently monitor and thus compare our reference marshes with our replicate restored marshes both with and without experimental pond connections, as field manipulations. We would compare persistent metals (Se, Hg, Pb), water quality, and biotic diversity and productivity (bird, fish, invertebrate, plant, and major algae populations), (4) identify and improve factors that enhance productivity such as maintain marsh ponds with moderate benthic algae, (5) identify and remedy limiting factors for key species and their food webs within restored marsh systems, specifically for delta smelt and Splittail, and (6) offer new training at the CSUH Contra Costa Campus.

4. Big Break and Marsh Creek Water Quality and Habitat Restoration Program, Coastal Conservancy

This pilot scale project will: 1) restore tidal marsh, floodplain, and Antioch dune habitat on the delta of Marsh Creek to restore target fish and dune species; 2) restore bio-filtration floodplains along urbanizing reaches of Marsh Creek to protect and improve water quality entering the Delta; 3) monitor aquatic species in Big Break and water quality along Marsh Creek; 4) develop a volunteer driven native plant nursery to generate plant material for restoration; 5) continue a public outreach, education, and citizen planning program in the watershed. The project will restore 30 acres of CALFED priority habitats including tidal marsh, seasonally inundated floodplain, riparian forest, and Antioch dune scrub. The project applicants will restore approximately 10 acres and 5,000 linear feet of bio-filtration floodplains in the Marsh Creek flood control channel in Brentwood.

5. Dutch Slough Tidal Marsh Restoration Project, Coastal Conservancy

The Dutch Slough site is the best - and perhaps the only - site in the Delta where the location, elevation, ownership, and physical configuration combine to create the opportunity for implementation of a large-scale tidal marsh restoration and research project. The project objectives are: 1) Implement a large-scale, locally supported restoration project that will serve the local community with shoreline access and other opportunities. 2) Restore the 1,200-acre Dutch Slough properties to a fully functioning, self-sustaining ecosystem that includes a mosaic of habitat types including shallow water, emergent marsh, inter-tidal marsh, seasonal wetlands and flood plains, Antioch dune scrub, riparian forest, and oak savannah. 3) Significantly contribute to the state of scientific understanding of floodplain and tidal marsh restoration through ongoing experimentation and monitoring under an adaptive management framework. The Dutch Slough site includes approximately 1200 acres on three adjacent parcels. The site is located on the Marsh Creek delta and the Big Break shoreline in the City of Oakley in northeastern Contra Costa County. The site's proximity to Big Break and Marsh Creek creates an opportunity to protect and expand a continuous area of tidal marsh and floodplain encompassing over 3,000 acres and eight miles of shoreline. If funding for acquisition and restoration is not obtained, the landowners have existing development approval for 4,500-6,100 housing units and the property will be developed.

6. Environmental and ecological assessment of the habitats in San Pablo Bay and Sacramento-San Joaquin Delta region using remote sensing technique, *UC Davis*

This is a research project which will be conducted in the San Pablo Bay and Sacramento-San Joaquin Delta. Ecosystem restoration in the Bay-Delta region requires a comprehensive understanding of the dynamic change and spatial variation of the ecological conditions and their potential risks to the ecosystem quality of the region. Remote sensing combined with GIS techniques provides a new approach for monitoring and assessing the ecological conditions on a regional scale. The objective of the study is to conduct an environmental and ecological assessment of the habitats in the Bay-Delta region using remote sensing combined with GIS techniques. We define the ecological conditions as indicated by biomass quantity, primary productivity, vegetation cover percentage, surface moisture, near-surface heat fluxes, water turbidity, sediment content, and chlorophyll content. Landsat TM and AVIRIS (airborne visible and infrared imaging spectrometer) data will be used in the study. Our hypothesis is that different ecological conditions have different spectral characteristics in visible, near infrared and thermal infrared bands of remote sensing data. The spectral features derived from remote sensing data can then be used to combine the ground sampling data, necessary meteorological data, and GIS datasets about soil, water and land uses of the region to estimate the above indicators for environmental and ecological assessment of the habitats in the region. The approaches include: (1) Developing algorithms and procedures to process the remote sensing images for spectral feature retrieval: vegetation index indicating vegetation status, water turbidity index relating to water sediment content, and surface temperature index indicating thermal features of the region. (2) Developing methods to estimate the above important indicators indicating the ecological conditions of the region. Usually there are two ways for the estimation of the indicators: correlation and modeling. In the study, we will combine these two methods for the estimation of the above indicators. (3) Obtaining spectral reflectance data and conducting ground sampling of the main surface patterns: vegetation, soil, water, and their various mixtures in the wetland-dominated region. (4) Assessing the ecological conditions in the habitats and analyzing their importance to the wildlife species in the region. The expected results will include (1) maps/images of the indicators to show the environmental and ecological conditions of the habitats in the region, (2) final report to document the study and papers for publishing in journals, (3) workshops/seminars/lectures presented to the audience concerning the ecosystem dynamics in the region, and (4) a website to present the data/maps/images and the documents of the research for public access.

7. Sustainable Restoration Technologies for Bay/Delta Tidal Marsh and Riparian Habitat, *HART, Inc*

This research and restoration project builds upon the experiences along the North Fork Mokelumne River and Georgiana Slough in the Delta. We have protected more than 11,000 linear feet of bank using wildlife friendly biotechnical techniques and several miles of tidal marsh restoration using specialized planting methods. These methods are “low-tech” and cost-effective. They have the advantage of involving minimal planning effort and permitting time, thus ensuring a quick turn-around of on-the-ground habitat restoration. The results of these efforts serve to protect levees while at the same time restoring valuable riparian and tidal marsh habitat. In some parts of the Delta, only a small fraction of natural (non-riprap) levees and embankments remain. Without this effort, these embankments would continue to be lost to environmentally unfriendly

bank treatments. On Georgiana Slough, our efforts have resulted in the immediate protection of natural, earthen embankments and obviating the need for the placement of riprap for the foreseeable future. We propose to continue these successfully proven methods along Georgiana Slough, as well as to initiate new efforts on the Sacramento River, (Brannan–Andrus Island); below Rio Vista at the base of Montezuma Hills; near Courtland; Steamboat Slough (Grand Island); Sutter Slough and Miner Slough (Reclamation District 999), and Suisun Marsh.

8. Shallow open water habitats: Hydrodynamics and benthic grazing, *Stanford University*

Shallow water regions of San Francisco Bay are thought to be of central ecological importance because they support high rates of primary production and because they may offer valuable habitat for many species of estuarine fish. However, primary production in shallow waters can be easily limited by benthic grazing by siphonate bivalves or by reduced light availability due to the resuspension of the fine bottom sediments found in these regions. The objective of the study is to develop, via field observation and modeling, a detailed view of how tides and wind-generated waves determine the physical structure and hydrodynamics of shallow estuarine waters, and how these physical processes can act to constrain net primary production through their effects on grazing and light. We will carry out field experiments in the shallows of Grizzly Bay and in Franks Tract. We will make simultaneous measurements of turbulence, flows, salinity, temperatures, sediment concentration, and chlorophyll concentrations for a series of intensive sampling periods. The specific aims of the experiments are to quantify the rate of benthic grazing as a function of bivalve density and physical conditions, and to quantify the effects of waves on shallow-water flows, mixing and sediments. Synthesis of these observations will provide crucial information to estuarine scientists and managers for assessing the effects of grazers like *Portamocorbula* and *Corbicula* on the estuarine food web, and for evaluating the effects of restoration activities on shallow water habitat.

9. McCormack-Williamson Tract Restoration: Wildlife-Friendly Levee Management, *The Nature Conservancy*

The McCormack-Williamson Tract offers an excellent opportunity to restore tidal freshwater wetlands, enhance riparian habitat, and potentially reduce flood damages. This island (1,654 acres) is located immediately downstream of the confluence of the Cosumnes and Mokelumne Rivers. Long-term planning for restoration and flood management is underway. The Nature Conservancy requests funds for a full-scale restoration project to implement the next phase of levee improvements. We hypothesize that levee resloping to a 5:1 slope with plantings will protect levees from interior wave erosion and maximize desired habitat attributes. We will reslope 20,000 linear feet of levee along the Mokelumne River shoreline to 5:1 slope, using on-site fill. We will plant the restored slope with native vegetation (trees, shrubs, grasses) to prevent erosion and create riparian habitat. The planting design will be based on results from a 2001 pilot project (reslope and plant 5,000 lf levee) and will test performance of different planting methods and native species. We propose implementation now, because levee protection is an essential element of any restoration design or floodway configuration that is under consideration, and because revegetating the inside slopes will require a long lead-time.

K. UPLANDS AND WILDLIFE FRIENDLY AGRICULTURE (*Four Projects*)

1. Delta Region Farmland Preservation and Private Lands Stewardship Program, *American Farmland Trust*

The American Farmland Trust (AFT) seeks funding to complete a phased project in the Delta Region Ecological Management Zones. Our overall project goal is to test a set of hypotheses that

further the understanding of how CALFED can meet the “Uplands and Wildlife-Friendly Agriculture” objectives. CALFED decision-makers need more information to “better understand the wildlife benefits of existing agricultural lands and agricultural practices.” Our first hypothesis for this proposal is that the only way to meet the upland wildlife habitat and wildlife-friendly agriculture restoration goals of CALFED is to establish a comprehensive plan for the preservation and improvement of the economic viability of high-value agricultural lands in the Delta Region Ecological Management Zones. Our second hypothesis is that the long-term viability of the ecosystem restoration goals and objectives for the Delta Region EMZ is inextricably linked to a healthy agricultural economy in this Region. A large part of our scope of work seeks to improve the state of knowledge of how existing agricultural lands and agricultural practices can benefit wildlife of concern to CALFED. By utilizing existing research and hopefully initiating several pilot projects, we hope to develop agricultural incentive programs for habitat enhancement and conduct comparative analysis of the effectiveness of different approaches to promoting wildlife-friendly agriculture. Our third hypothesis is that once a land-use and strategic investment plan is developed for the long-term viability and protection of agricultural lands in the Delta Region EMZ, there are still regulatory barriers to implementing large-scale “wildlife-friendly” agricultural practices. Our fourth hypothesis is that a regulatory “mutual assurances” policy must be developed for the Delta EMZ if the Implementation Plan and ERP-MSCS are ever to be achieved. Our fifth hypothesis is that “wildlife-friendly” agricultural programs can be developed on a large enough scale in the Delta Region EMZ to conduct a meaningful comparative analysis of how different agricultural practices and different restoration practices selected at-risk species.

2. Strategies for incorporating wildlife-friendly agriculture in the Delta and East Tributaries Region of California, *CSU Hayward*

The agricultural ecosystems of many farming areas of the United States in the east, west and north-central regions present complex decision making environments for farmers who have to cope with volatile commodity markets, complicated, ever-changing farm programs, adoption of new farming technologies, escalating public concern over the effects of pesticide pollution, soil erosion, water quality and increasing intervention by governments with their rules, regulations and incentives. Wildlife and habitat considerations then are not high on their list of priorities, and the perception that wildlife is a by-product of agriculture remains widespread even today. In recent years various conservation tillage practices have become increasingly popular among farmers because they reduce farm preparation costs and because herbicides are available that lessen the need for mechanical weed control. Recent studies on conservation tillage have shown that dramatic increases in wildlife abundance and species richness from invertebrates to small mammals, occur in farmlands incorporating such farming techniques both on temporal and spatial scales. The proposed project is a research and restoration effort to find out what wildlife-friendly agricultural methods are (or can be) used in this region and to compare the effectiveness as a basis for further refinement or expansion in the agricultural areas. This project will also look at human issues focusing on understanding landholder psychological, socio-economic and ecological factors that may influence how landholders make decisions on what to do on their lands. Further, the project will also identify what incentives work (or need to be incorporated) in this agricultural area to encourage farmers to practice farming methods favorable to wildlife. To assess wildlife species composition, distribution and abundance in both agricultural areas and nearby "reference" areas, several techniques will be used. Information about farming activities that reduce runoff, landholder incentives that will encourage inception of wildlife-friendly agriculture methods by landholders, and an evaluation of the institution needs of landholders that will help and support wildlife-friendly farming methods will be appraised from the literature, interviews and from discussions with experienced workers in this field. The outcomes of the proposed project will include: biotic assessments which will provide performance measures allowing us to improve our approaches and incorporate adaptive management; understanding

what motivates landholders, their needs, their attitudes towards what we are proposing, how they perceive their roles in this process, how they can help and above all, their participation and co-operation; information on the incentives necessary in this region and the institutional needs that would help to engage landholders in habitat conservation matters.

3. Central Valley Wildlife Friendly Agriculture Program, Ducks Unlimited

Ducks Unlimited Inc has been delivering a technical assistance program to Sacramento Valley and North Delta agricultural operations for the past eight years through its Agricultural Technical Assistance Program (ATA Program). This request proposes that Ducks Unlimited ATA Program be expanded to include the South Delta and San Joaquin regions. Project objectives include:

- Become a resource to the agricultural community to implement wildlife friendly agricultural practices.
- Develop partnerships with state and federal agencies, agricultural organizations and conservation organizations to design and implement wildlife friendly agricultural practices.
- Establish criteria for wildlife friendly agricultural pilot projects.

Key Uncertainties include:

- Long-term viability of existing agricultural programs.
- Adequate incentive payments to gain acceptance.
- Funding sources for new practices/pilot projects.
- Available water resources for proposed wildlife friendly agricultural practices.
- Acceptance of practices by neighboring farmers and communities.

Expected Outcome:

- Contact with agricultural entities and agencies for program acceptance.
- An inventory of all existing wildlife friendly agricultural programs including program requirements, incentive payments and contact organization/person, etc.
- Annual monitoring reports showing wildlife use, ecological conditions, species' health and cultural changes/acceptance in the agricultural community.
- A technical report on wildlife friendly agricultural criteria for CALFED wildlife friendly agricultural projects using adaptive management principles.

4. Staten Island Wildlife-Friendly Farming Demonstration, Ducks Unlimited

An unsurpassed opportunity exists for a pilot/demonstration project on Staten Island to (1) support and improve wildlife-friendly agriculture that will foster recovery of at-risk native species such as greater Sandhill crane and (2) to investigate the effects of different agricultural management practices on wildlife populations and water quality. Staten Island is recognized nationally as an important site in California for wintering waterfowl and is unsurpassed in the Delta as wintering habitat for greater and lesser Sandhill cranes; there are few if any places in the Delta where the opportunity to have positive impacts on wintering waterfowl and sustainable agriculture exists at such a large scale. This is Phase II of a three-phase conservation initiative for Staten Island that is designed to ensure permanent protection, maintain agriculture, and provide optimal management for the Island. Phase I, which was funded in a separate proposal by TNC, involves land acquisition and baseline monitoring. Phase III will be the development and implementation of restoration and monitoring plans to address uncertainties and guide future management actions to promote wildlife-friendly agriculture. The project has two basic components: infrastructure construction component consisting of low interior cross levees and a high volume discharge pump to improve water management capability on the Island, and a project-monitoring component, which will evaluate water management practices effects on habitat use by target species and on water quality, specifically dissolved carbon being discharged from the Island.

L. X2 RELATIONSHIPS *(One Project)*

1. Determining the mechanisms relating freshwater flow and abundance of estuarine biota (the "Fish-X2" relationships): Phase I, SF State University, Romberg Tiburon Center

Freshwater flow to the San Francisco Estuary is regulated in part using a salinity standard based on "X2", the position of the 2 psu isohaline. The standard is based on the "fish-X2" relationships, by which abundance or survival several of estuarine species is higher when X2 is seaward and flow is high. The X2 standard is a rare example of ecosystem management, but it has several drawbacks. It is a crude tool: although the relationships are numerous and strong when compared to results from other estuaries, they are not strong enough to suggest ways to refine the seasonal pattern of protection. As statistical relationships, they provide no guidance for what will happen if the ecosystem changes through long-term effects including CALFED actions. The high cost of the water required suggests a need to make the standard as efficient as possible. Although some research has already been conducted, there is no coordinated, systematic effort to resolve these mechanisms. We propose to begin to understand these mechanisms by planning and designing a coordinated, interdisciplinary research effort, and by conducting some initial modeling studies to prepare for field research in subsequent years. The planning effort will draw on the experience and knowledge of numerous Bay Area scientists, using a workshop format to produce an optimum design for the program. Complementary modeling studies will use a 3-dimensional numerical hydrodynamic model of the estuary to investigate mechanisms involving the spatial distribution of salinity, and the effect of varying freshwater flow and X2 on retention of estuarine organisms. The resulting research program will provide CALFED with vital information needed for long-term management and restoration of the estuarine ecosystem.